Unit 12 Barratt Trading Estate, Denmore Road, Bridge of Don, AB23 8JW

User Manual
Quin BOP Assembly
6-3/8 - 10K

This Manual Covers the Following Part Numbers:

195-5631

Revision History

Issue, Date	Remarks
Rev A, 12/11/13	Initial Issue

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Safety

WARNING: Trapped air requires considerable time to compress and when it is compressed is highly dangerous. It has enough stored energy to separate parts with considerable force.

This product contains high pressures, when in operation. Failure of any part may cause injury. Welding, corrosion, rough handling, or other abuse may affect the Integrity of this product.

All pressure equipment has a particular pressure rating and care must be taken to ensure that no item is used in a situation that may cause its working pressure to be exceeded.

All personnel involved in pressure testing must be formally trained, competent and utilise the appropriate PPE.

Ensure the identification plate is fitted and is displaying the correct information

This equipment and the equipment it is attached to is heavy never position yourself below a suspended load

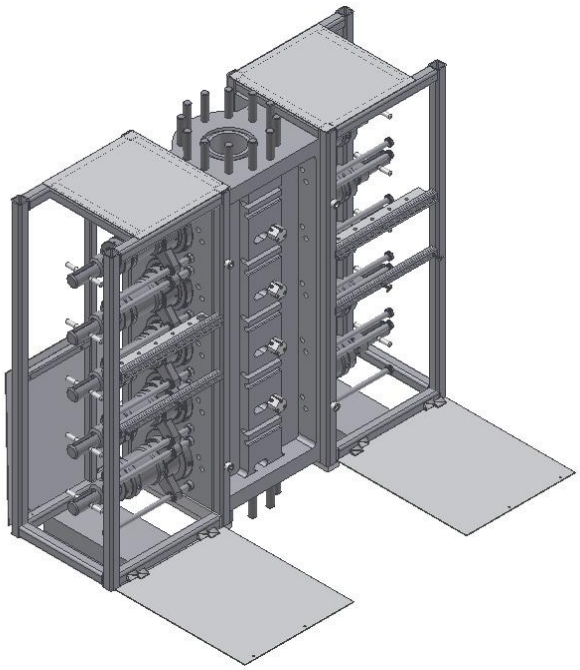


Figure 1: BOP Safety

1 Introduction

1.1 General

The Deployment Blow out Preventer (BOP) provides essential safety barriers against well pressure during the deployment operation. It is located directly above the wellhead flange and immediately below the Deployment Window. The BOP has five sets of rams: two pipe rams that seal against the deployment bar; two wire-line rams for sealing against braided line and one shear and seal ram that is capable of cutting through the deployment bar and then sealing against the well pressure.

Each ram consists of a standard and interchangeable actuator assembly. A hydraulic piston can be extended or retracted to energise or retract the rams. Each ram has a set of inner and horse shoe seals that when compressed against the opposite ram forms a continuous seal that is further energised by the application of pressure in one direction. The rams consequently can be arranged so that they hold pressure from below the BOP or from above.

The actuators are connected with hard hydraulic piping to provide sealing integrity during a fire. The hydraulic circuit includes a ram valve on each of the four upper ram pairs to allow one half of the rams to be extended without the other half. This is used during the deployment operation when setting the pipe rams against the deployment bar and ensures that the bar is not damaged by the slight misalignment of the two sets of pipe rams. The shear rams do not have a ram valve for safety reasons.

Between each of the ram pairs it is possible to inject pressure or grease through the injection port. For the deployment operation this can be used to create an area of pressure that is greater than wellhead pressure and thus provide a safety barrier. For braided line operations or in cases where an effective seal cannot be achieved with fluid, the injection port can be used to inject grease at pressures greater than the well head pressure. The injection port has a check valve to prevent well pressure entering the injection lines and also has a gauge port that allows the pressure between the rams to be monitored during the deployment operation.

Across each pair of rams there is an equalisation valve assembly. This is used to equalise pressure across the rams so that the rams can be withdrawn to open up the well bore. The equalisation valve assembly consists of a cone seal set on a screw. Unwinding the screw opens the valve and allows equalisation across the rams. Tightening the screw closes the seal and prevents pressure from passing through the valve assembly.

As part of the detection system the BOP has six possible locations to mount the magnet sensor. The normal Wireline operation uses the upper and lower most locations but other configurations may be used when shorter bar assemblies are being used for perforating guns. The deployment bars used must match the locations used in the BOP, as the spacing of the magnets is critical to successful operation. The sensor housing is a separate part from the BOP body and is manufactured from non-magnetic steel in order to maximise the sensitivity of the detection system.

The BOP is mounted to a crash frame assembly that provides forklift pockets protection during transport. The crash frame has foldable platforms for the operators to stand on when operating the BOP and stabbing in the lubricator (not shown in diagrams below).

This user manual serves as an introduction to the equipment and contains the relevant specifications, operation, planning and maintenance instructions, parts list and drawings.

1.2 Product Identification

Phuel products are identified by a unique serial number that facilitates full product traceability. Each product is supplied with a documentation pack that contains product certification and material/inspection reports. The serial number is always etched on the surface of the product but can sometimes be difficult to find or read after painting. A customer identification number is also included to allow the customer to track the asset in their system.

A stainless steel band secures the nameplate tag that is stamped with the information shown below. This tag should be located in the first instance to ensure that this manual refers to the correct equipment.

2 Technical Specification

Part No	195-5631-HV0	
Top Connection	7-1/16 BX 10K Flange	
Bottom Connection	7-1/16 BX 10K Flange	
Height	75.8”/1.93 m	
Make-up Height	65”/1.65 m	
Width	23.78”/0.6 m	
Working Pressure	10,000 PSI (690 Bar)	
Test Pressure	15,000 PSI (1035 Bar)	
Service	H_2S	
Hydraulic Pressure	3,000 psi (210 Bar) Max (Standard Actuators) 5,000 psi (345 Bar) Max (Shear Actuators)	
Stroke Volume (Standard Act)	105 cu-in to close – 100 cu-in to open – Total=205 cu-in (3.36 litres)	
Stroke Volume (Shear Act)	105 cu-in to close – 100 cu-in to open – Total=205 cu-in (3.36 litres)	
Weight	8251 lbs. (3,743 Kg)	
Hydraulic Connections	Pipe Rams – 3/8” Phoenix Beattie HP Quick Release Coupling (QR74 Range)	
	Wireline Rams - 3/8” Phoenix Beattie HP Quick Release Coupling (QR74 Range)	
	Shear Rams – 1/2” Phoenix Beattie HP Quick Release Coupling (QR74 Range)	
	Actuators – ¼” NPT x 3/8” Tube	
	Grease Injection – ½” NPT (10,000 psi max WP)	
	Gauge Port – Autoclave SF250CX	

Table 1: Technical Specification

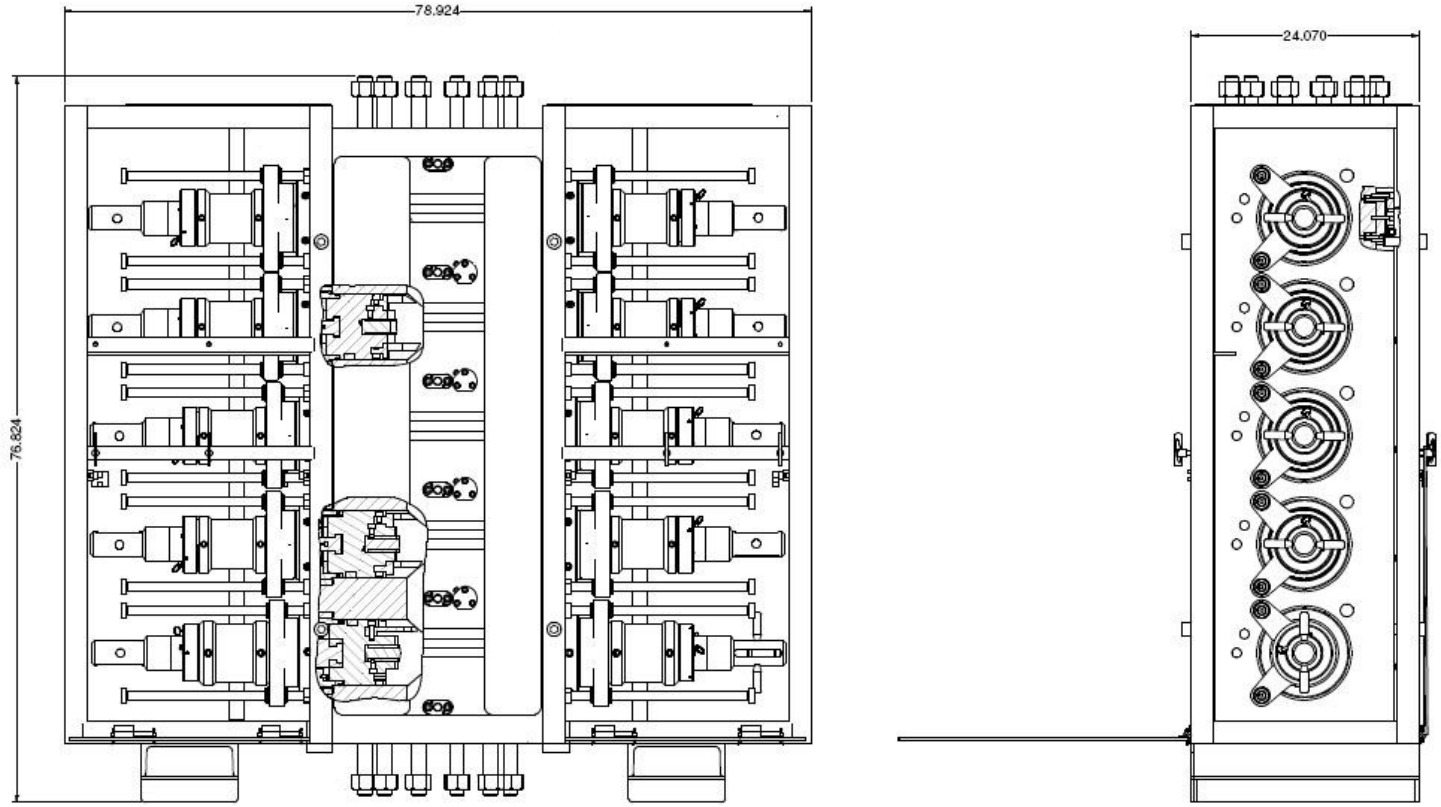


Figure 2: BOP General Layout

3 Technical Description

The Phuel Deployment BOP provides a positive barrier against well pressure while performing intervention operations. The equipment consists of five sets of hydraulically operated rams (Figure 3) that can be individually pumped closed to form a seal against pressure. The orientation of the ram outer seal determines whether the rams hold pressure from above or below. By opposing adjacent ram sets it is possible to apply pressure between the rams through a grease injection port, normally at a pressure greater than the well pressure, and thus form a positive protection barrier. This technique is particularly effective when sealing against braided wire-line as a leak tight seal cannot be obtained due to the construction of the wire. The high viscosity of the grease allows the pressure to be maintained even though a small leak (of grease) still exists.

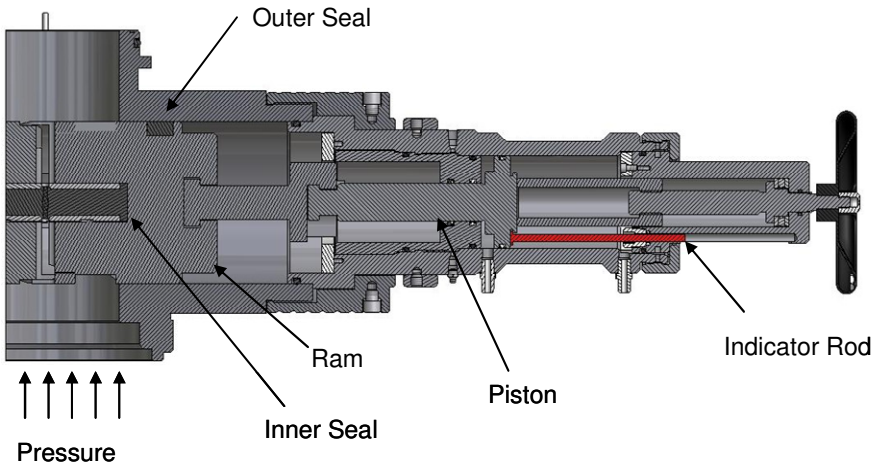


Figure 3: Section through BOP rams (closed position)

For standard deployment operations the top two rams are used as pipe rams to seal against the deployment bar. The next two sets are used when running wire-line operations and the last is a shear and seal set for cutting either the deployment bar or the wire and then sealing in the event of a dangerous situation arising. The standard configuration of the rams outer seals are shown in Figure 4 and allows grease to be injected between the two pipe rams to maintain a positive barrier against well pressure if required and the same for when sealing on braided line if required.

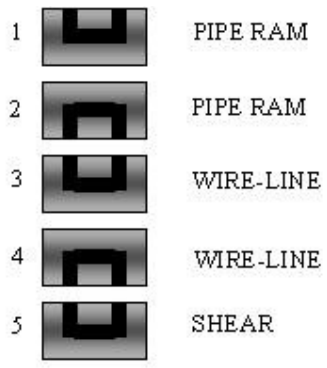


Figure 4: Ram Configuration

The rams are driven by a hydraulic actuator, which consists of a piston with an indicator rod to provide visual confirmation of the position of the rams. A manual locking mechanism is also provided to ensure that when the BOP is closed hydraulically during operations it cannot be opened again until the mechanism is deliberately withdrawn. Each of the actuators assemblies are identical on the Phuel deployment BOP and so can be positioned in any ram bore. This provides excellent flexibility for maintenance and redress of the equipment.

4 Operation

4.1 Operating the Rams

Note – Always ensure that the pressure across the rams has been equalised before opening.

4.1.1 Hydraulic Operation

The BOP has been provided with hard piping to offer the required fire protection level. Two connections are required for each ram set for open and close. It is important that both connections are connected, as the fluid displaced by the movement of the piston must be allowed to pass through the valve system back to the reservoir.

A Well Control Unit (WCU) is normally used to operate the BOP in an offshore environment. Refer to the relevant manual for that equipment for details of operation and connection. An alternative pump pack may be used for onshore maintenance work but the operation of this equipment is out with the scope of this manual.

When closing the two sets of pipe rams to seal on the deployment bar, the manual hydraulic valves on the right hand side must be closed to allow the left hand rams to stroke out fully first. This ensures that the two rams are vertically aligned which is essential to avoid bending the bar or twisting it with respect to the lubricator axis. When the left hand rams are fully stroked (as seen by the position of the indicator rod), open the manual hydraulic valves and continue to pump closed, thus introducing the right hand rams to the bar. If the manual locks are required then follow the procedure below to ensure that they can be operated

4.1.2 Manual Operation

The rams can be closed manually (but not opened again) by turning the hand wheel in a clockwise direction some 30-40 turns providing that the hydraulic fluid from the other side (open port) is allowed to escape. The hydraulic connections must still, therefore, be made up to the WCU even when intending to operate the rams manually.

Once the rams have been closed using the manual method it is not possible to open them again without hydraulic pressure. The Hand wheel, however, must still be turned in an anti-clockwise direction until it stops to allow the piston to move fully back.

4.1.3 Using the Locking Mechanism in Deployment Operations

After closing with hydraulic pressure the piston can be mechanically locked by winding in the manual mechanism. Turning the hand wheel in a clockwise direction will advance the locking mechanism by 3mm per turn. It is therefore necessary to turn the hand wheel 30-40 turns to lock in the piston. Continue to turn until the hand wheel stops, indicating that the piston is now against the back-up lock.

For safety reasons and to reduce the mechanical effort required, **Phuel recommends that the hydraulic pressure be removed or reduced while closing the mechanical back up**. This reduces the risk of injury caused by the failure of a seal under hydraulic pressure and decreases the time required to implement the back up feature.

It is important to remember that the manual lock must be fully withdrawn before the rams can be opened. The mechanism is rated for operation at full working pressure or at full hydraulic pressure but not both at the same time. Strict measures must be taken to ensure that the BOP is not accidentally opened against the back up mechanism when the well pressures are in excess of 4,500 psi. Damage to the mechanism may result and it may not be possible to fully withdraw the rams. There would, however, be no expected loss of pressure containment as a result if this failure.

4.1.4 Proper Use

In the event that the BOP is closed against wire during an operation, it is essential that the Inner seals are replaced after that job has been completed. Working practice and procedures must reflect this requirement.

Blind shear seals should always be fitted on the shear rams. They should be tested regularly to verify that they are suitable for operation. If they are ever closed during a live well operation they should be replaced when the operation is complete.

4.1.5 Bleed Down Rate in Gas Wells

To avoid explosive decompression in gas wells (or oil wells were there is a large quantity of gas present) it is important to control the bleed down rate of the pressure. The following procedure is recommended:

1. Reduce pressure from 10000 to 2000 Psi at a rate of 1000 psi per minute
2. Reduce pressure from 2000 psi to 1000 psi at a rate of 100 psi every one minute.
3. Reduce pressure from 1000 Psi to zero at a rate of 20 psi per minute.

4.2 Equalising across the rams

The Equalisation Valve is situated at each set of rams and allows the pressure to by-pass the closed ram seals and thus allows the pressure to be equalised. It is important to realise that the piston forces on the ram seals are significant so it is not possible for the hydraulic actuator to open the rams even with small differential pressure. It is therefore essential that the pressure be equalised before the rams are opened.

To open the equalisation valve insert a 5/16” or 8mm hex key into the valve. Turn anti-clockwise slowly by one half to one turn. The movement of fluid should be noticeable either by sound or by the vibration felt through the key. It is recommended that the valve be left opened until the rams have been withdrawn.

To close the valve, use the same key and tighten in a clockwise direction. There is no need to use excessive force when closing as doing so may result in damage to the seal face. Always ensure that the valve is closed when attempting to seal pressure across the rams.

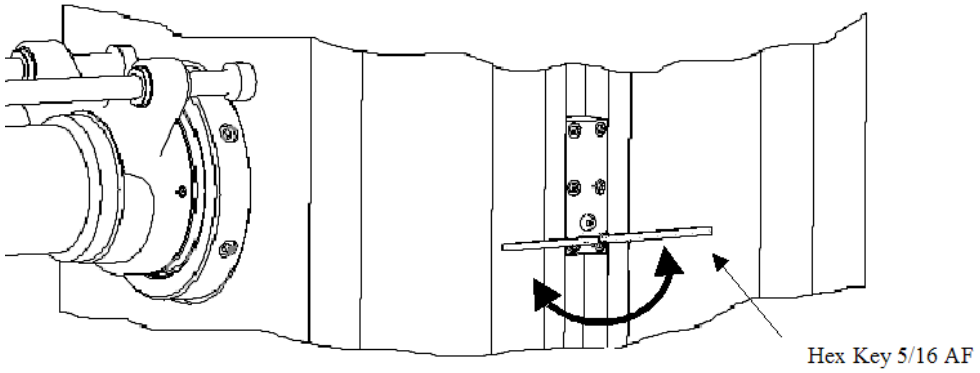


Figure 5: Using a 5/16 A/F Key to equalise pressure across rams

4.3 Injecting pressure between rams

To provide a positive pressure barrier, fluid (grease) is injected between two sets of opposing rams. Simply connect the outlet of the fluid pump to the connection on the injection port.

An optional gauge port is provided to allow a pressure gauge to be connected so that the pressure can be monitored. This is necessary due to the presence of the check valve that prevents well pressure escaping into the fluid pumping system. The check valve therefore prevents the injected pressure from being bled back and so may prevent the pump system gauge from displaying the actual pressure between the rams. The gauge connection is an autoclave SF250CX port so fittings to attach to the gauge will be readily available from hydraulic fitting suppliers.

The check valve can be disabled by referring to section 6.7 and re-building without the ball and spring. Ensure that the final system still meets any obligatory safety requirements before using in a well pressure environment.

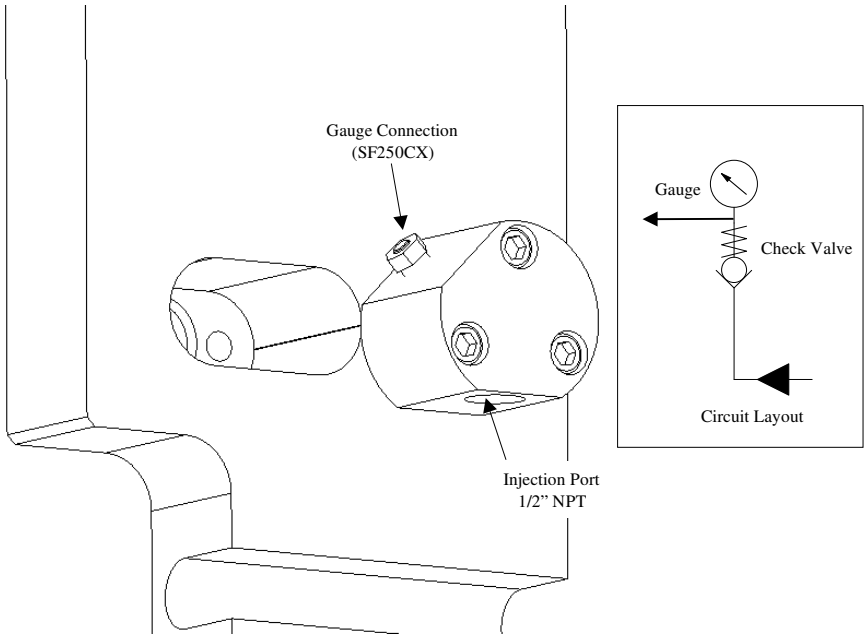


Figure 6: Injection Assembly

4.4 Fitting the Magnet Detector

The magnet detector simply slides into the bore provided by the non-magnetic Sensor Housing. It most cases the weight of the cable is not sufficient to pull the sensor out, but just in case the sensor can be retained by the means of two ¼-20 UNC x 1.5" long screws. Always ensure that the sensor has been pushed fully home as even a small distance can have a large effect on the sensor detection ability.

Refer to the specific bar operating manual to determine which sensor positions are to be used for the deployment operation as different bar configurations may require different detection positions be used.

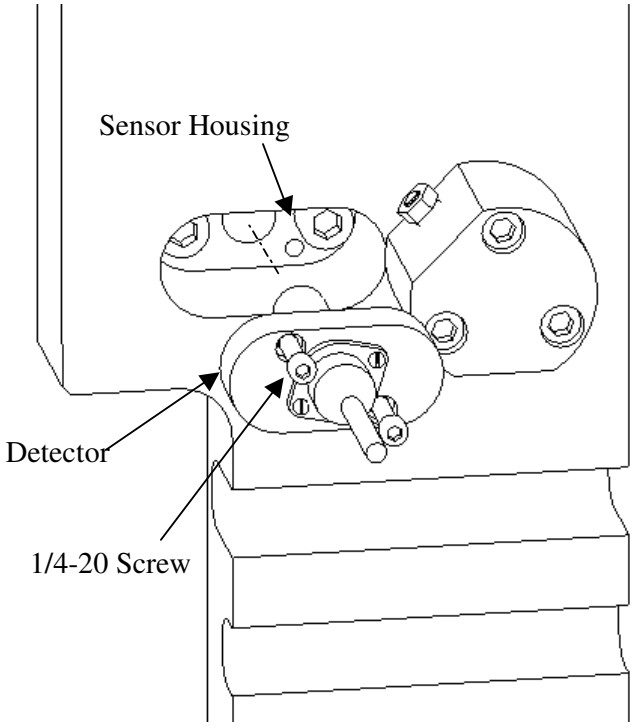


Figure 7: Fitting the Detector

4.5 Job Planning

4.5.1 Before the Job

- Check that the certification is within date and that the scheduled maintenance is up to date.
- All blind (shear) inner seals need to be inspected after 30 pressure cycles, and replaced where necessary. Wire-line seals must be tested without the use of test rods and must always be replaced after being closed on wire during normal operations. Always inspect the wireline seals for signs of wear or damage and replace if necessary.
- Examine the BOP Assembly, to make sure that it is good operating order and assembled with the Rams in the correct orientation for the desired operation.
- Functioning of the Rams may be checked, by running both Rams to the closed position. Do not exceed the maximum operating pressure when closing the Rams. Pressure test the rams from the direction of the well (or applied) pressure that is expected during the operation. This also verifies that the rams are in the correct orientation.

4.5.2 During the Job

- Special care should be taken that the Rams are fully open when passing any equipment through them. The impact of a collar hitting a Ram may damage the Ram to such an extent that the Ram may no longer Seal, or prevents it from fully opening.
- Only lift the BOP using suitable lift caps. Do not sling or attach lifting equipment to the crash frame to lift the BOP assembly.
- Care should be taken to completely remove any residual pressure or accumulated pressure existing on Lubricator equipment above the BOP, before disconnecting the Lubricator or opening the window.
- Hydraulic Hose ends should never be allowed to drop in to dirt or grit, or otherwise become contaminated with foreign matter. Any dirt or grit introduced into the BOP is very injurious to the equipment. If hoses become dirty, they should be cleaned thoroughly with solvent and dried.
- Only clean Hydraulic fluid should be used (Shell Tellus 22 is recommended) to operate the BOP. The use of mixed types, dirty, or very old fluid of unknown origin is not recommended. When one of these conditions is known or suspected, the hydraulic system should be flushed with solvent and the hydraulic fluid replaced.

4.5.3 After the Job

After each job, the BOP should be stripped down, thoroughly cleaned, repaired as may be required and redressed (redress procedures are in section 5).

5 Operational Characteristics

5.1 Sealing Characteristics

5.1.1 Minimum Hydraulic Pressure

Testing has confirmed that the BOP requires 1500 psi minimum hydraulic closing pressure to close and seal when there is no initial well bore pressure. The required closing pressure increases as the well bore pressure increases due to the effects of the well pressure acting against the piston rod. The table below should be used a guideline of the minimum closing pressure that can be applied for various well pressure levels.

Initial Well Bore Pressure	Min Hydraulic Pressure
zero to 4,000 psi	1,500 psi
4,000-6,000 psi	2,000 psi
6,000 to 10,000 psi	3,000 psi

Table 2: Minimum hydraulic pressure to seal

5.1.2 Opening the BOP with differential pressure

Due to the large actuator pistons It is not recommended that the BOP should ever be opened with differential pressure across the rams. The pressure should always be equalised first, using the equalising valves. **Operational safe guards must be put in place to prevent opening when there is still differential across the rams**. *If the actuators are opened at pressures greater than 2,000 psi with differential pressures greater than 2,000 psi, then failure of the actuator will occur. This will not affect sealing integrity but will disconnect the rams from the actuator and render the BOP useless.*

When the rams are closed against well bore pressure, it is possible for the rams to open if the closing pressure is lost. The manual locking feature should therefore be used when the BOP is closed to prevent accidental opening in this situation.

5.1.3 Sealing Limitations

The pipe rams can seal at maximum working pressure without limitations.

The wireline and shear rams can be closed up to well pressures of 8,000 psi and are able to hold a differential pressure of just 500 psi. At well pressures greater than this, a small differential pressure cannot be maintained and it is recommended that a minimum differential of 2,800 psi is created to guarantee the ram seal. This should be considered in the job planning and reflected in the operational practices

5.2 Fatigue Testing

Testing has been performed to establish the fatigue limit of the actuators and shear rams so that preventative maintenance can be scheduled to replace worn seals or parts.

A total of 546 close/open cycles have been completed without failure including 78 pressure cycles to maximum working pressure. This test simulates closing and opening the BOP once per day and testing well bore pressure at 300 psi and 10,000 psi once per week for 1.5 years of service. Records must be maintained to ensure that the seals are replaced before this limit is exceeded. If records do not exist then the seals should be changed every year as a minimum.
Fatigue life has not been defined on the wireline seals due to their less critical function and the fact that these are to be replaced whenever they are closed on the wire. Pre-job inspection to verify their condition is therefore required and replacement is necessary if they are not in good physical condition.

5.3 Ram Access Testing

Testing has been performed to determine the ability of the BOP to undergo repeated ram changes without affecting operating characteristics. The tests have shown that the rams were accessed a total of 200 times (test limit) without failure of the sealing or locking mechanism. Records must be maintained to ensure that the seals are replaced before this limit is exceeded. If records do not exist then the seals should be changed every year as a minimum.

5.4 Shearing Performance and limitations

Testing has been conducted to verify the shearing and sealing capabilities of the shear rams. The table below shows the results of these tests. The minimum tool string weight must be achieved either by direct weight or the combination of that and additional tension to ensure that the cutting performance is achieved.

Wire Size (dia)	No of wires	Wire Type	Minimum Tool String Weight	Hydraulic Pressure needed to shear at zero bore pressure	Maximum Wellbore Pressure (psi)
0.125”	1	Slick line	250 Kg	500psi	10,000 psi
0.125”	6	Slick line	250 Kg	500 psi	10,000 psi
0.160”	1	Slick line	250 Kg	500 psi	10,000 psi
7/32”	1	Braided	250 Kg	500 psi	10,000 psi
7/32”	2	Braided	250 Kg	700 psi	10,000 psi
9/32”	1	Braided	250 Kg	500 psi	10,000 psi

5/16”	1	Braided	250 Kg	500 psi	10,000 psi
7/16”	1	Braided	250 Kg	750 psi	10,000 psi
15/32”	1	Braided	250 Kg	800 psi	10,000 psi

Table 3: Wire Shearing performance and limitations

Deployment Bar Assy (ref)	Shear Sub (Shear Diameters) Material	Shear Pressure
206-2598-HH0	206-2605-475 (1.38 OD / 0.50 ID) 4130 60K Carbon Stl	4,000 psi (No Booster) 2,667 psi with Booster Will shear at 10,000 psi WP (with Booster)
206-4586-HV0	206-2620-316 (1.38 OD / 1.00 ID) 316 St Stl	2,600 psi (No Booster) 2,600 psi with Booster Will shear at 10,000 psi WP (with Booster)

Table 4: Deployment Bar Shearing performance and limitations

Note – **The shear blades are to be inspected after each cutting operation and replaced if the leading edge is damaged.**

5.5 Performance of Ram Guides

Testing has been conducted to verify that the wireline rams can centralise the cable without cutting – at extreme wire positions and with applied side loadings. The rams always closed without incident or damage to the cable. Operational planning and set up should still attempt to minimise the expected side loading on the wire by ensuring the lubricators are vertical and that the tool string is centralized as much as possible in the well bore.

5.6 Temperature and Pressure Limitations

Testing has been conducted to verify the performance of the BOP at extreme operating temperatures.

5.6.1 General Sealing

The BOP seals (typically of 90 hard Viton material with part numbers listed in this manual) have been qualified for operating temperatures between -10C and 121C with no restrictions to the operating pressure.

5.6.2 Blind Ram Shear Seals

The shear rams (using blind ram shear seals part number 190-5306-H80) have been qualified for operation between -9C and 121C with no restrictions to the working pressure.

Gas testing has determined that the seal at full working pressure was bubble tight.

5.6.3 Wireline Multi-Seals

The wireline multi-seal (part number 190-5307-H80) are qualified to be used within the operating envelope shown below. If operations dictate that the expected surface temperatures and pressures exceed the operating envelope then wire specific inner seals and rams must be used instead of the standard multi-seal.

It should be noted that the point (82C, 690 bar) has been qualified on the basis of extrapolated test results and not directly confirmed by testing. API 16A does not require qualification below 82C. Care should be taken when operating close to this point and further qualification testing may be required to confirm suitability.

Consult Phuel Oil Tools for advice and part numbers.

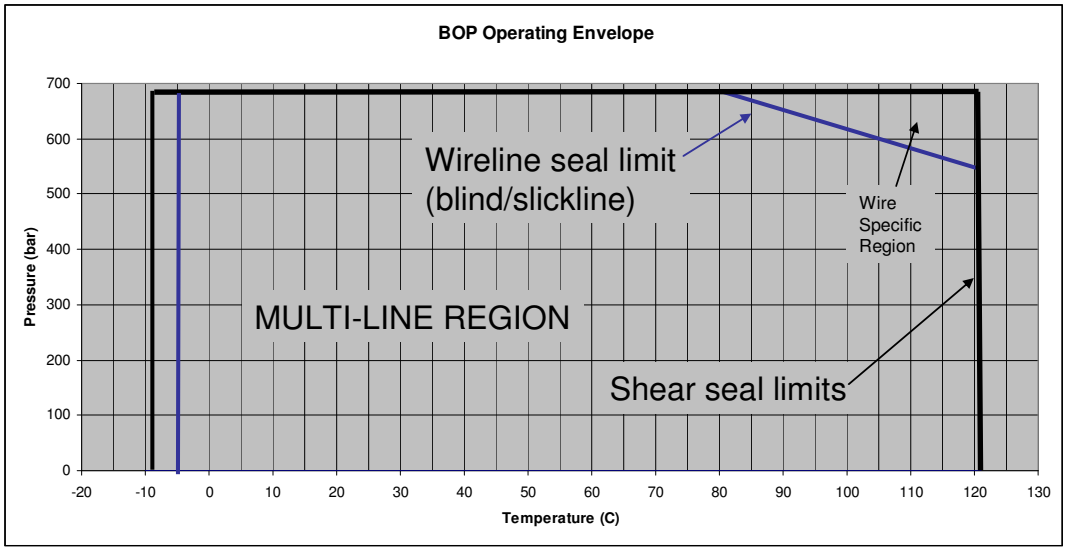


Figure 8: Qualified Operating Envelope

6 Maintenance

6.1 Introduction

Regular maintenance of the equipment using Phuel redress kits or approved spares is essential to its continued safe operation. Ensure that the pre and post job operating procedures are followed and that maintenance records are kept.

6.2 Schedule

The maintenance schedule may be governed by international or company standards and the following is considered to be the minimum requirements.

6.2.1 Pre & Post Job

Refer to Section 4.5.1and Section 4.5.3 for details.

6.2.2 Yearly

- Disassemble BOP (para 6.5 to 6.8) clean and degrease all components.
- Inspect the condition of sealing surfaces and surface coatings, repair/replace as necessary.
- Re-coat threads and sealing surfaces if necessary. Contact Phuel if in doubt.
- Replace all elastomeric seals.
- Re-assemble BOP (para 6.5 to 6.8).
- Pressure Test to maximum working pressure and 300 psig per API 6A – PSL3 (Witnessed by certifying authority where applicable).
- Inspect paintwork and repair where necessary.

6.2.3 Five Yearly

- Yearly maintenance, plus the following.
- Carry out surface NDE on all component threads and damaged surfaces.
- Pressure Test to maximum test pressure and 300 psig per API 6A – PSL3 (Witnessed by certifying authority where applicable).

6.3 Safety

- This product contains high pressures, when in operation. Failure of any part may cause injury. Welding, corrosion, rough handling, or other abuse may affect the Integrity of this product.
- Many of the components are heavy and should not be lifted without lifting aids.
- Wear appropriate personal protective equipment.
- Do not over exert yourself while using torque wrenches. Use appropriate mechanical advantages when available.

- Ensure that all tools and equipment are in good condition and are suitable for intended use.

6.4 Tools

The following tools are required.

- Non marking Memac Chain Wrench.
  Other pipe wrenches may be used but will mark equipment.
- Piston Seal Sub Assembly Tool (Part No. 900-1577-400).
- Allen Key's (7/32, 5/16" & 3/8" long version for removing Actuators from the BOP).
- Adjustable Spanner's.
- External Circlip Pliers.
- ¼"-20 UNC Socket Head Cap Screw x 1" Long.
- Pair of Long Nose Pliers.
- Large Flat ended Screwdriver.
- Hide or Rubber Mallet.
- Silicon Grease.
- Seal Grease
- Oil spillage-cleaning kits.
- 5K Hydraulic pump and Gauge to operate Actuators.
- Lifting equipment/Aids, as required.

6.5 Ram Seal Redress

Note: If rams are required to be removed ensure they have been pumped forward until only 2" of the indicator rod is visible

6.5.1 Access Rams

This procedure results in the removal of the actuator assembly from the BOP body in order to gain access to the rams.

- Ensure Rams are fully opened.
- Back off the Actuator from the BOP using the extended 3/8" Allen Key in the Cap Screw heads on the Locking Sleeve. Do not loosen the cap screws during this process.
- Once the thread is fully disengaged, pull the Actuator fully back to the End Stops.

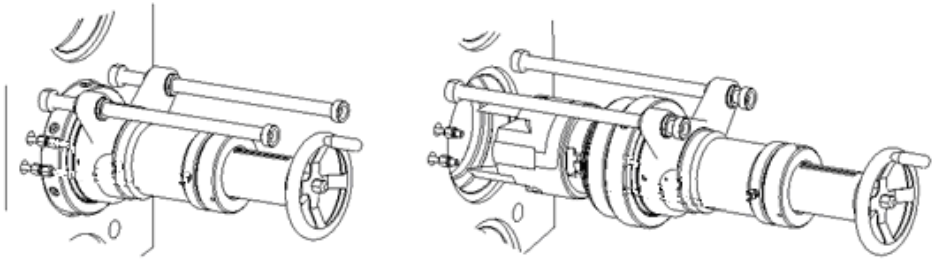


Figure 9: Accessing the rams

6.5.2 Ram Removal (not required to redress ram seals)

- Remove Ram from Actuator, by sliding the Ram off the Ram Tee.

6.5.3 Pipe Ram & Shear Ram Seal Redress

- Remove the Cap Screw (6) on the Guide (2) or Shear Blade (5) (whichever Ram is being re-dressed).
- Un-screw the two Cap screws (5) on the Ram to remove Inner Seal (4).
- Remove Outer Seals (3), by using a flat-ended screwdriver to lever the seal from the groove. Take care not to damage the metal seal face of the Ram.
- The Ram is now completely stripped down. Clean and inspect all parts for evidence of damage or excessive wear. Check the seals and replace if required. Repair or replace any damaged or worn parts. If the seals are to be redressed use the parts from the specified redress kit.
- Assemble Outer Seals (3) by pushing the tab into the slot in the ram and working it around the radius of the ram. Tap home using a rubber or hide mallet and if required use a screwdriver to lever the second tab over the edge of the slot. Take care not to significantly damage Seal during assembly but expect that some slithers of rubber will be produced as the corners of the rubber seals are removed by the assembly operation. Tap all around the circumference of the seal to ensure that it is bedded into the groove and that the seal is not protruding above the ram diameter.
- Slide the Inner Seals (4) into Ram, make up Cap Screws (5) and gently tighten. Check that there is still some float in the seals as this is essential for the correct operation of the rams. Back off the cap screws slightly if required to get the seals to float.
- Assemble the Guide (2) (or Shear Blade (2), whichever is being assembled), apply thread lock such as Loctite to the Cap Screw (6) make-up and tighten.

6.5.4 Wireline Ram Redress

- Slide the Inner Seals (4) from the Ram and remove the Outer Seal (3) as above. There are no screws or guides on this assembly.

6.5.5 Re-attach to BOP Body

- If the rams were removed from the actuator (Section 6.5.2) then slide the ram back onto the Tee taking careful note of the orientation of the rams depending on its intended use for the BOP assembly. (i.e. if pressure is to be held from below then the outer seal must be on top – otherwise it must be on the bottom). Attach a hydraulic pump to the open port of the actuator and pump the rams back into the recess in the actuator ensuring that the ram does not hang up on the actuator front face. When fully back remove the hydraulic pump.

Note - It is still possible to assemble the actuator to the BOP without pumping back the rams but more effort may be required to allow the thread to make up.

- Apply a generous coating of grease to the inner and outer seals.
- Push the Actuator back into BOP Body taking care that the edges of the guide pass into the seal bore and make-up the thread using a 3/8" hex key in the cap head screws to provide the torque. Making up the thread will drive the actuator assembly fully home.

Note – When making up Actuator thread into the BOP Body, ensure the Hydraulic line fittings line up, with the Actuator Lines, as the Actuator is being made up.

- Make up the hydraulic fittings hand tight. Do not over tighten as this causes problems when disassembling again later.
- The Ram Assembly is now fully made up. Repeat this procedure for each ram seal that need to be replaced.

6.6 Equalisation Block Redress

This procedure results in the complete dis-assembly and re-assembly of an Equalisation Block Assembly for redress purposes.

6.6.1 Disassembly

- Back off the six Cap Screws (6) holding the Equalisation Sub (1) on the BOP Body.
- Pull the Block from the BOP Body. (If its difficult to remove try screwing the longer screw in to the tapped hole where the button screw (5) is fitted to gain more leverage
- Remove the O-rings (7).
- Remove Button Head Screw (8) and Nordlock washer (10).
- Back off, remove Equalisation Valve (2), and remove O-Rings (4).
- Remove the valve seat 8 using a hex key
- The Equalisation Block is completely stripped down. Clean and inspect all parts for evidence of damage or excessive wear. Discard the O-Ring seals and replace them with new ones. Repair or replace any damaged or worn parts.

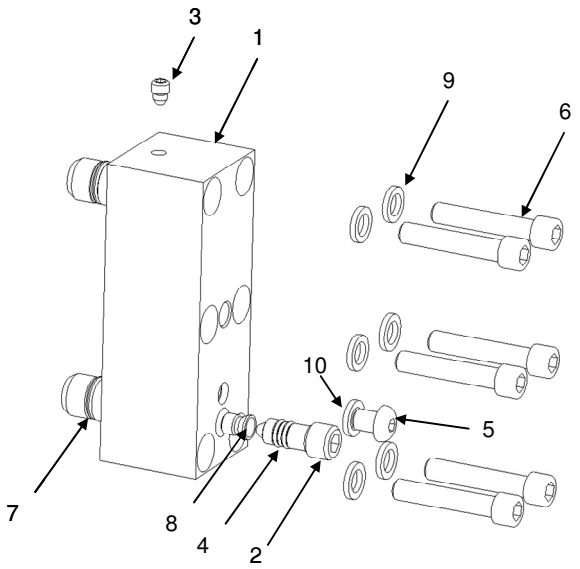


Figure 10: Exploded View of Equalisation Assembly

6.6.2 Re- Assembly

Before actual Assembly begins, all parts should be carefully cleaned and greased using good quality lightweight grease.
Ensure that seals are not damaged or excessively stretched during assembly. Use new seals from the specified redress kit and check that the dates are within a useable period.

- Insert the valve seat into the block and screw fully in but do not over tighten as the hex can be easily damaged and become difficult to remove again
- Invert the Equalisation Valve (2) and screw into the Equalisation Sub (1). Using two pieces of string assemble the O-Rings (4). Be very careful not to cut or damage the O-Ring while assembling.
- Remove the Equalisation Valve (2) from the Equalisation Sub (1), and assemble in the correct position as shown. Gently tighten.
- Assemble the Button Head Screw (5) with Nordlock Washer (10) and tighten.
- Assemble the O-Rings (7) and lightly grease.

6.6.3 Final Assembly

- Mount Equalisation Sub (1) on BOP Body and apply thread locking substance such as Loctite to Cap Screws (6) together with the lock washers (9). When making up Cap Screws, make-up one, then do the opposite, continue doing this until all six are made up. Tighten Screws.

6.7 Grease Injection Assembly Redress

This procedure results in the complete dis-assembly and re-assembly of a Grease Injection Assembly for redress purposes.

6.7.1 Disassembly

- Back off the three Cap Screws (8) holding the Grease Injection Sub (1) on the BOP Body.
- Gently pull the Grease Injection Sub (1) out of the Body.
- Remove the O-ring (7).
- Back-off Hollow Lock Screw (2), remove Compression Spring (3) and Check Valve (6).
- Remove the Autoclave Gland (5) from the Grease Injection Sub (1), and remove the Autoclave Plug (4).
- The Grease Injection Assembly is completely stripped down, clean and inspect all parts for evidence of damage or excessive wear. Discard the O-Ring seals and replace with new one. Repair or replace any damaged or worn parts.

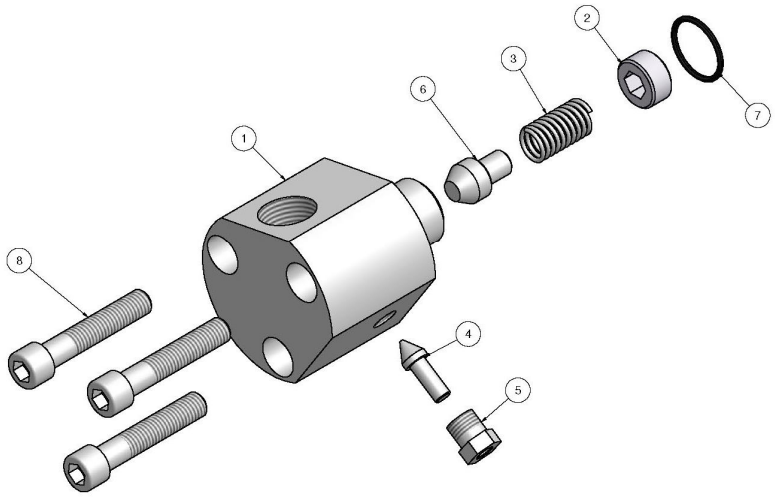


Figure 11: Grease Injection Assembly

6.7.2 Re-assembly

Before actual Assembly begins, all parts should be carefully cleaned, inspected and greased, using good quality lightweight grease.
Ensure that seals are not damaged or excessively stretched during assembly. Use new seals from the specified redress kit and check that the dates are within a useable period.

- Insert Check Valve (6), followed by the Compression Spring (3) into Grease Injection Sub (1).
- Make-up the Hollow Lock Screw (2), ensure the Screw is flush to sub flush to the Spigot face.

- Make up Autoclave Plug (4) and the Autoclave Gland (5) into the Grease Injection Sub (1) and tighten by hand.
- Assemble the O-Ring (7).

6.7.3 Final Assembly

- Push the Grease Injection Sub (1) into the BOP Body ensuring correct orientation. Apply thread lock substance such as Loctite to Cap Screws (8) make up and tighten.

6.8 Sensor Housing Redress

This procedure results in the complete Dis-Assembly of a Sensor Housing Assembly for redress.

6.8.1 Disassembly

- Back off and remove the Cap Screws (16).
- Screw in a ¼" Socket Head Cap Screw into one of the Sensor holes on the Sensor Housing (7) face. Using a pair of Pliers, grip the ¼" Screw, head and ease the Sensor Housing (7) out of the BOP Body. Remove the ¼" Cap Screw.
- Remove O-Ring (17).
- The Sensor Housing is completely stripped down, clean and inspect for evidence of damage or excessive wear.

6.8.2 Re-assembly

Before actual Assembly begins, all parts should be carefully cleaned, inspected and greased, using good quality lightweight grease.
Ensure that the seal is not damaged or excessively stretched during assembly. Use new seals from the specified redress kit and check that the dates are within a useable period.

- Assemble O-Ring (17).
- Gently push the Sensor Housing (7) into the BOP Body, make-up the Cap Screws (16) and tighten.

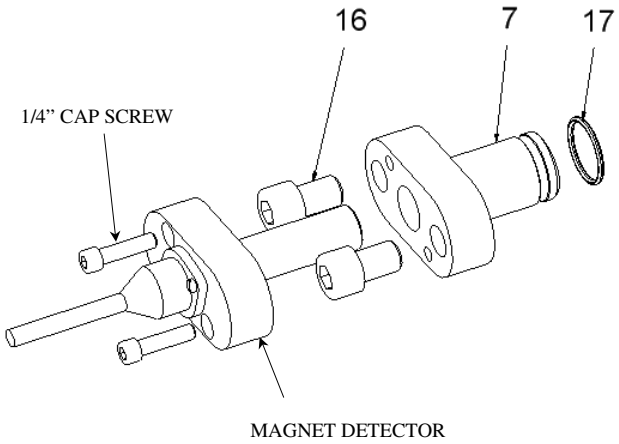


Figure 12: Sensor Housing components

6.9 Maintenance Record Sheet

Date Performed	Type of Maintenance	Performed By	Verified By	Comments

Table 5: Maintenance Record

7 Testing

All testing is to be carried out in the designated test area and by suitably qualified and competent personnel.

WARNING: Trapped air requires considerable time to compress and when it is compressed is highly dangerous. It has enough stored energy to separate parts with considerable force

7.1 BOP

- Using Appropriate test caps blank off either end of the BOP
- Fill with test fluid and bleed off any air in the system
- Apply a pressure of 500 psi and ensure pressure holds for a minimum of 10 minutes
- Increase pressure to 10,000 psi (Maximum Working Pressure), allow to stabilise and maintain this pressure until it is evident there are no apparent leaks. .(Testing to be carried out to Test pressure when decreed by maintenance schedule)
- Remove pressure and remove the top test blank
- Close the upper wireline rams
- Apply a pressure of 500 psi and ensure pressure holds for a minimum of 10 minutes
- Increase pressure to 10,000 psi (Maximum Working Pressure), allow to stabilise and maintain this pressure until it is evident there are no apparent leaks.
- Release pressure
- Remove hollow lock screw, spring and ball bearing from upper grease injection port
- Ensure test fluid is above the top wireline ram
- Close both wireline rams
- Apply a pressure, (through the grease injection port) of 500 psi and ensure pressure holds for a minimum of 10 minutes
- Increase pressure to 10,000 psi (Maximum Working Pressure), allow to stabilise and maintain this pressure until it is evident there are no apparent leaks.
- Release pressure, open rams and re-assemble the upper grease injection port
- Close upper Pipe ram
- Apply a pressure of 500 psi and ensure pressure holds for a minimum of 10 minutes
- Increase pressure to 10,000 psi (Maximum Working Pressure), allow to stabilise and maintain this pressure until it is evident there are no apparent leaks.
- Release pressure

- Remove the hollow lock screw, spring and ball bearing from the grease injection port between the 2 pipe rams (3rd from the top)
- Close both pipe rams
- Apply a pressure, (through the grease injection port) of 500 psi and ensure pressure holds for a minimum of 10 minutes
- Increase pressure to 10,000 psi (Maximum Working Pressure), allow to stabilise and maintain this pressure until it is evident there are no apparent leaks.
- Release pressure, open rams and re-assemble the upper grease injection port
- Close Shear Ram
- Apply a pressure of 500 psi and ensure pressure holds for a minimum of 10 minutes
- Increase pressure to 10,000 psi (Maximum Working Pressure), allow to stabilise and maintain this pressure until it is evident there are no apparent leaks.
- Bleed off pressure, drain test fluid and dry
- Remove test caps and plug
- Apply coating of de-watering solution to protect the bore and threads

7.2 Actuator

- Connect both ports to a suitable pump system (preferably with two way valve and reservoir). Use a good quality hydraulic fluid (Tellus 22).
- Pump into the open port to fill the system and drive the piston fully back. Do exceed the maximum operating pressure of the cylinder (3,000 psi). Reverse the direction of the valve and pump the piston to the fully open position to displace any remaining air for the system.
- Increase pressure to 3,000 psi and maintain for 10 minutes to ensure that all seals are holding. Reverse the valve and pump the piston to the closed position. Increase the pressure to 3,000 psi and maintain for 10 minutes to ensure that all seals are holding. Strip down and replace any seals that are leaking until this test can be achieved successfully.
- Remove the pump.

7.3 Equalisation Block

- The Equalisation Block Assembly can either be tested along with the final BOP assembly or can be individually tested using test Fixtures, which must be purchased from Phuel separately. This procedure assumes the use of the test fixtures.
- Attach the test fixture and make up all six bolts. Blank off Port 2 and attach a hand pump and gauge pump to port 1.
- With the valve open fill the fixture and pressure test to 10,000 psi for 5 minutes. Bleed off. Pressure test to 300-500 psi for 10 minutes then increase pressure to 10,000 psi for 10 minutes. Bleed off. This test checks that all of the seals are functioning correctly
- Close the valve without exerting excessive force and repeat the pressure test. This test verifies that the metal seal is working. Remove the test fixture and use the same o-rings (6) when assembling to the BOP.

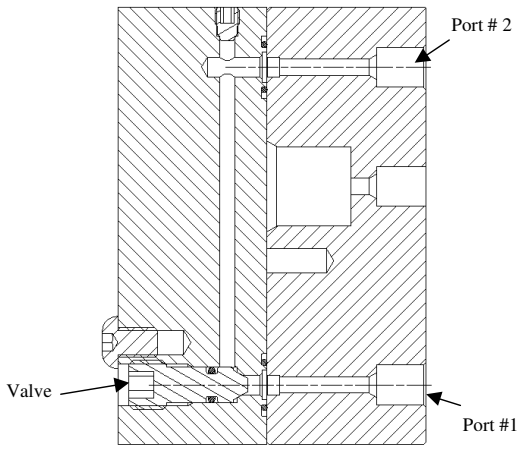


Figure 13: Test Fixture Layout

7.4 Grease Injection Assembly

- The Grease Injection Assembly can either be tested along with the final BOP assembly or can be individually tested using test Fixtures, which must be purchased from Phuel separately. This procedure assumes the use of the test fixtures.
- Attach the test fixture and make up all three bolts.(see Figure 14)
- Attach a pump and gauge to port 3. Pressure test to 10,000 psi for 5 minutes. Bleed off. Pressure test to 300-500 psi for 10 minutes then increase pressure to 10,000 psi for 10 minutes. Bleed off. This test checks that all of the seals are functioning correctly.

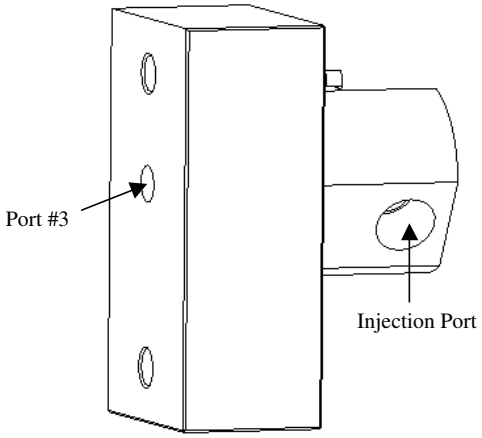


Figure 14: Testing Set Up

On completion of all maintenance ensure the maintenance record sheet (Para 6.9) is completed

8 Parts List and Drawings

Item Number	Part Number	Quantity	Description
1	195-2049-480	1	QUIN BOP BODY 6-3/8
2	190-5632-HV0	10	6-3/8 ACTUATOR ASSY
3	190-1863-HH0	5	EQUALISATION BLOCK ASSEMBLY
5	190-2787-HV0	4	GREASE INJECTION ASSEMBLY
6	190-1765-HH0	2	PIPE RAM ASSEMBLY
7	190-3863-HH0	2	6 3/8 WIRELINE RAM ASSEMBLY
8	190-5633-HH0	1	SHEAR RAM ASSEMBLY
9	190-5660-X90	20	SLIDER ROD (40MM X 20.44")
10	190-4261-316	20	END STOP V3
11	206-1860-NI5	6	SENSOR HOUSING
12	195-2203-STL	1	CRASH FRAME
13	SHC-0586-3A4	12	SOC HD CAP SIZE 1/2" UNC LEN 1.25 IN
14	801-0119-V90	6	O-RING - B.S SIZE 119
15	CSU-0585-3A4	20	CSINK SOC HD SIZE 1/2 UNC LEN 1 IN
16	WNL-0580-316	12	WASHER NORDLOCK (M12)
18	195-1745-AL7	24	THREADED STUD (1-1/2UN X 7.5)
19	SHC-0752-HTS	8	SOC HD CAP SIZE 1 LENGTH 3.5 IN
20	128-2280-A2H	24	HEAVY DUTY NUT 1.500-8 UN
21	195-5719-HS0	1	DEPLOYMENT BOP HYDRAULIC KIT

Table 6: BOP Parts List Part No 195-5631-HV0

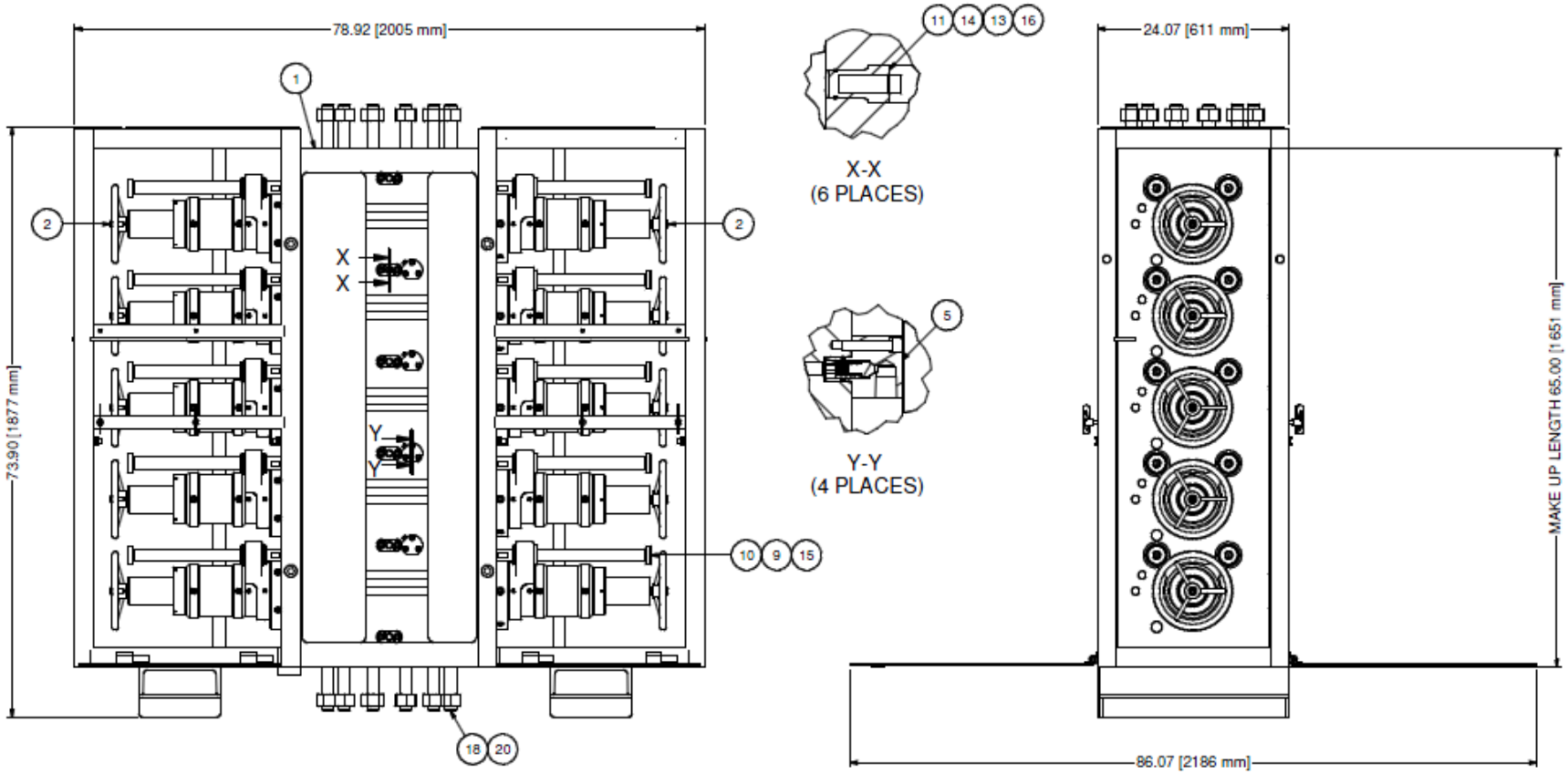


Figure 15: BOP Assembly 195-5631-HV0 (sheet 1/2)

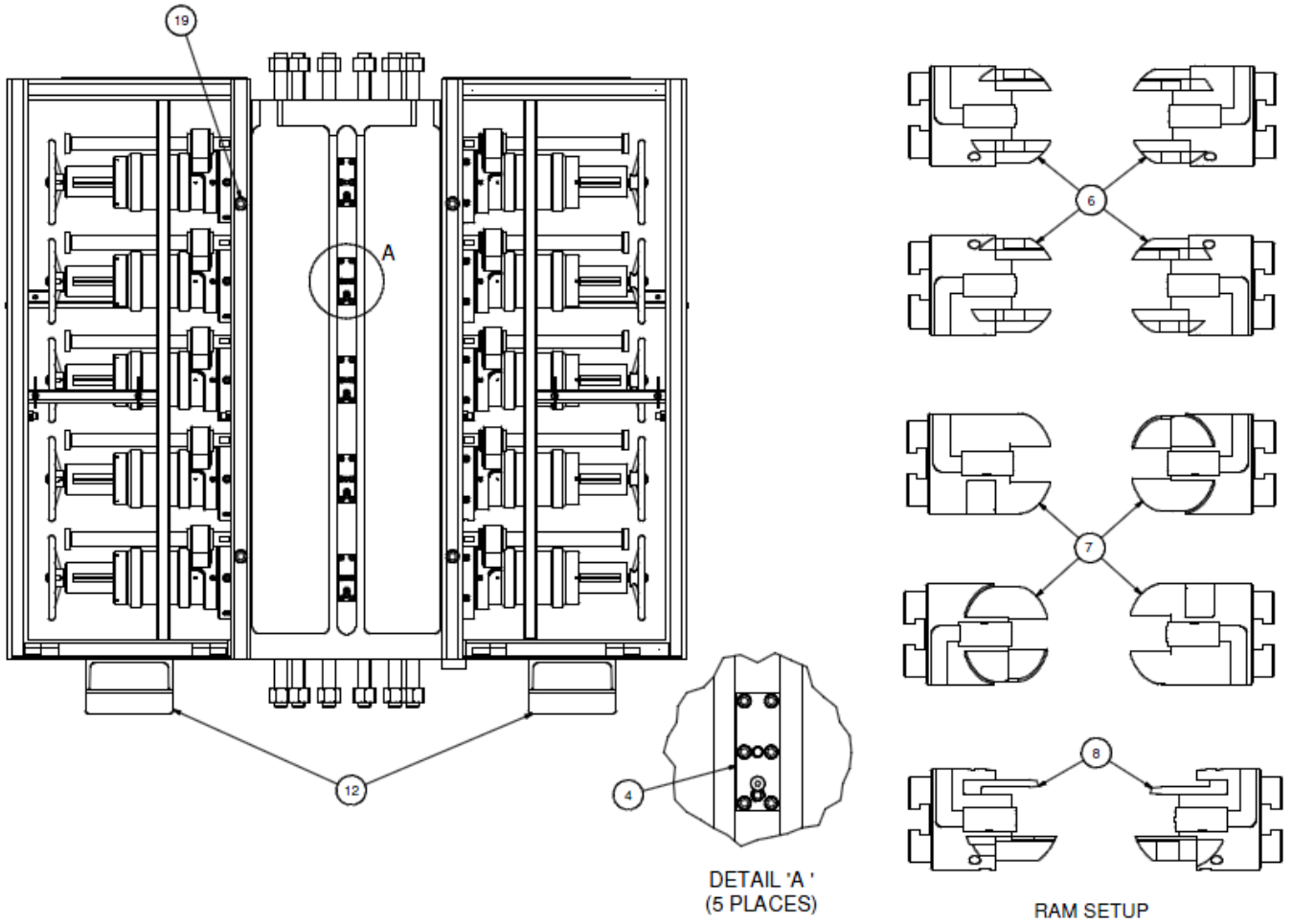


Figure 16: BOP Assembly 195-5631-HV0 (sheet 2/2)

Item Number	Part No	Quantity	Description
1	190-3705-480	1	GUIDE RAM -6-3/8
2	190-3706-480	1	SINGLE GUIDE RAM 6-3/8
3	190-1715-H70	2	OUTER SEAL
4	190-5307-H80	2	WIRELINE 7.00 INNER SEAL

Table 7: Wireline Ram Assembly Parts List (190-3863-HH0)

Item Number	Part No	Quantity	Description
1	190-1707-480	2	PIPE RAM
2	190-1710-STL	4	PIPE RAM GUIDE
3	190-1715-H70	2	Outer Seal
4	190-1748-H90	2	PIPE INNER SEAL
5	190-1739-B7M	4	RAM SHOULDER SCREW
6	SHC-0582-B7M	4	Soc Hd Cap Size 1/2 Length 0.625in

Table 8: Pipe Ram Assembly Parts List (190-1765-HH0)

Item Number	Part No	Quantity	Description
1	190-5669-480	2	SHEAR RAM
2	190-5306-H80	2	BLIND 7.00 INNER SEAL
3	190-1715-H70	2	OUTER SEAL
4	190-1739-B7M	4	RAM SHOULDER SCREW
5	190-1705-STL	1	SHEAR BLADE SET
6	SHC-0587-316	2	SOC HD CAP SIZE 1/2 UNC LEN 1.5IN
7	SHC-0581-316	2	SOC HD CAP SIZE 1/2 UNC LEN 0.5 IN
8	190-5630-B21	2	SHEAR RAM GUIDE

Table 9: Shear Ram Assembly Parts List (190-5633-HH0)

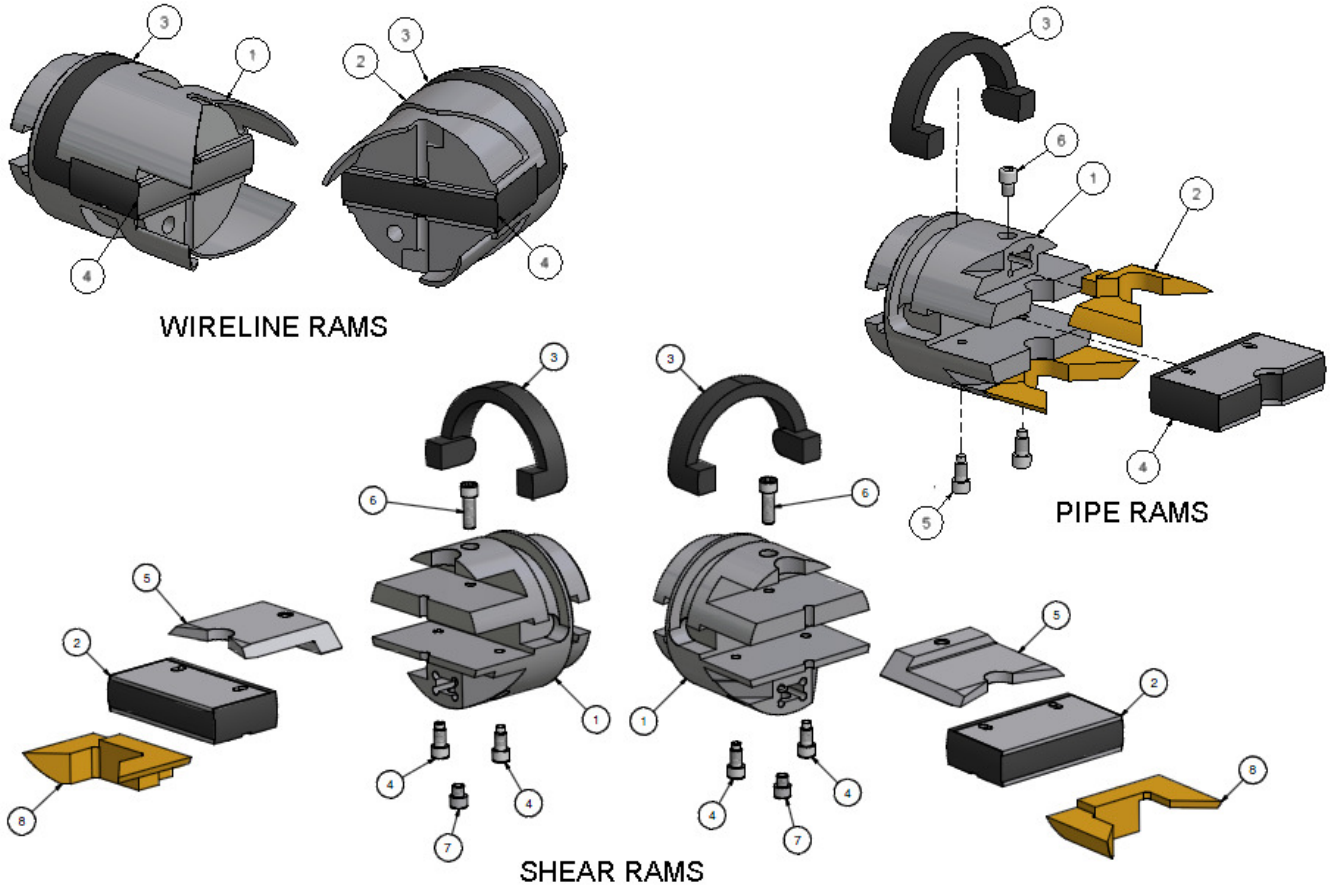


Figure 17: Ram Assembly Drawings

Item Number	Part No	Quantity	Description
1	190-2072-480	1	SHEAR PISTON HOUSING
2	190-2071-480	1	SHEAR SEAL SUB
3	190-2069-480	1	LOCKING SLEEVE
4	190-2073-480	1	SHEAR PISTON
6	190-1649-480	1	CAP COLLAR
7	190-2927-480	1	ROTATE CYLINDER CAP
8	190-2772-411	1	DRIVE ROD
9	190-1726-480	1	DRIVE SLEEVE
10	190-1645-316	1	INDICATOR ROD
11	190-5667-STL	1	MODIFIED RAM TEE
12	190-1611-480	1	RAM KEY PLATE
13	190-1773-STL	1	DRIVE KEY PLATE
14	802-2163-H85	1	PISTON T-SEAL
15	190-1696-STL	1	THRUST BEARING
16	190-3870-H85	2	ROD SEAL 1.985
17	801-0439-V90	1	O-RING - B.S SIZE 439
18	801-0354-V90	1	O-RING - B.S SIZE 354
19	801-0345-V90	1	O-RING - B.S SIZE 345
20	190-4246-304	1	HAND WHEEL 250MM
21	SHC-0503-B7M	4	SOC HD CAP SIZE ¼ UNC LEN 0.5 IN
22	SHC-0585-316	6	SOC HD CAP 1/2 UNC LEN 1" IN
23	SDU-0582-HTS	3	SET SCREW DOG POINT 1/2 UNC X 0.625 IN
24	190-1704-STL	1	ACORN NUT 1/2-13 UNC
25	802-1699-H85	1	ROD T-SEAL ASSY
26	802-2505-H85	1	ROD T-SEAL
27	190-2491-STL	1	EXTERNAL CIRCLIP - 0.750 DIA
28	WNL-0580-316	6	WASHER NORDLOCK (M12)
29	SDU-0503-HTS	1	SET SCREW DOG POINT SIZE 1/4 LEN 0.5 IN
30	190-4245-STL	4	SPIRAL SHAFT RING (62MM SHAFT)
31	950-5080-STL	2	LINEAR BEARING
32	190-5635-ALU	1	DPS ACTUATOR BRACKET (40MM)
33	WNL-4266-316	1	NORDLOCK WASHER (NL3/8" SP SS)
34	100-2179-STL	1	GREASE NIPPLE 1/8 NPT

Table 10: Actuator Parts List (190-5632-HV0)

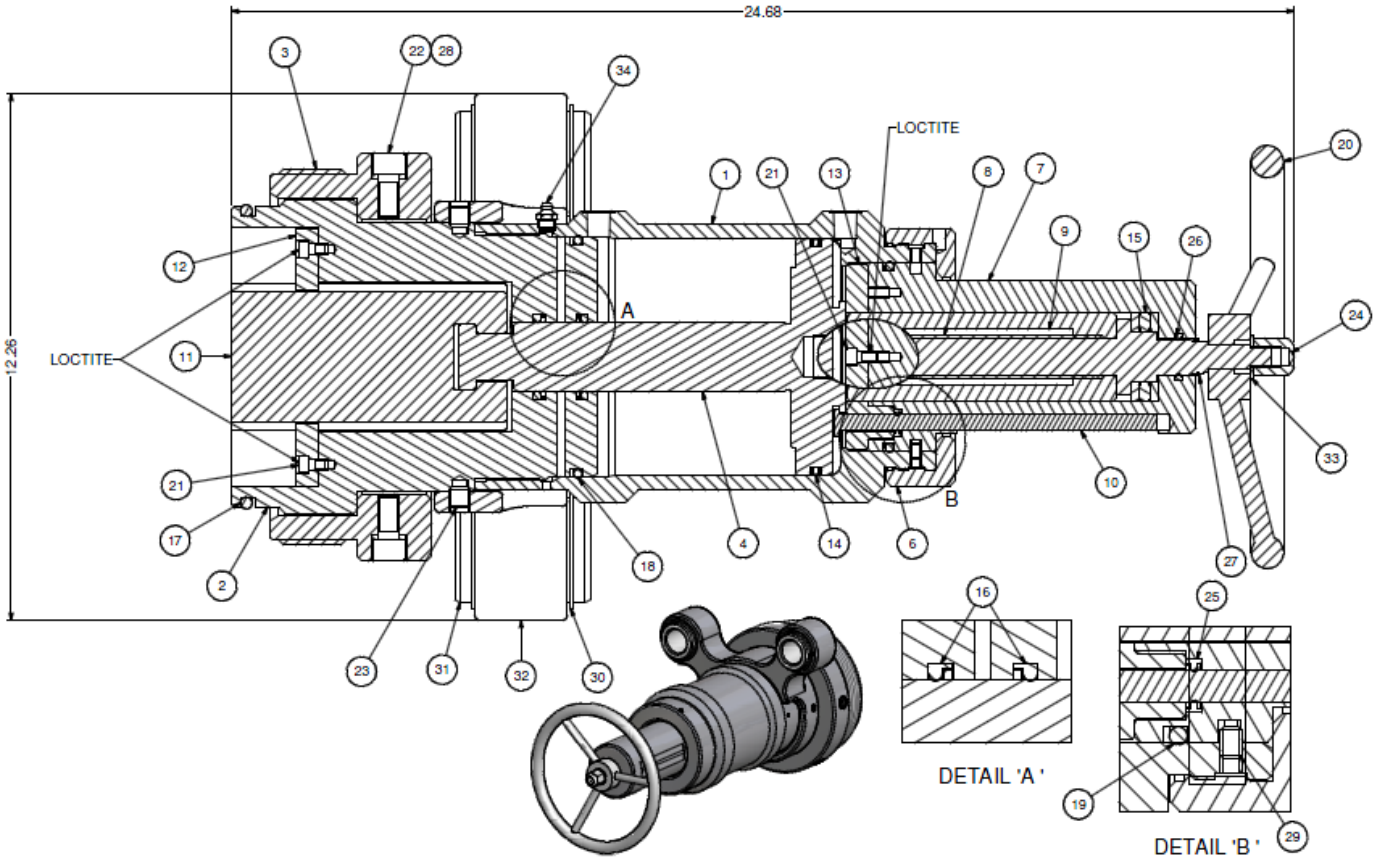


Figure 18: 6-3/8 Actuator Assembly (190-5632-HV0)

Item Number	Part Number	Quantity	Description
1	190-1861-480	1	EQUALISATION BLOCK
2	190-1871-316	1	EQUALISATION VALVE
3	190-1758-416	1	AFO PLUG
4	801-0011-V90	2	O-RING - B.S SIZE 011
5	SBC-0542-316	1	BUTTON HD SCREW SIZE 3/8 LEN 0.5 IN
6	SHC-0551-AL7	6	SOC HD SCREW 3/8 UNC X 2.0 LONG
7	801-0113-V90	2	O-RING - B.S SIZE 113
8	WNL-0540-316	8	NORDLOCK WASHER SIZE 3/8
9	190-2823-PEK	1	VALVE SEAT

Table 11: Equalising Block Assembly Parts List Part No 190-1863-HH0

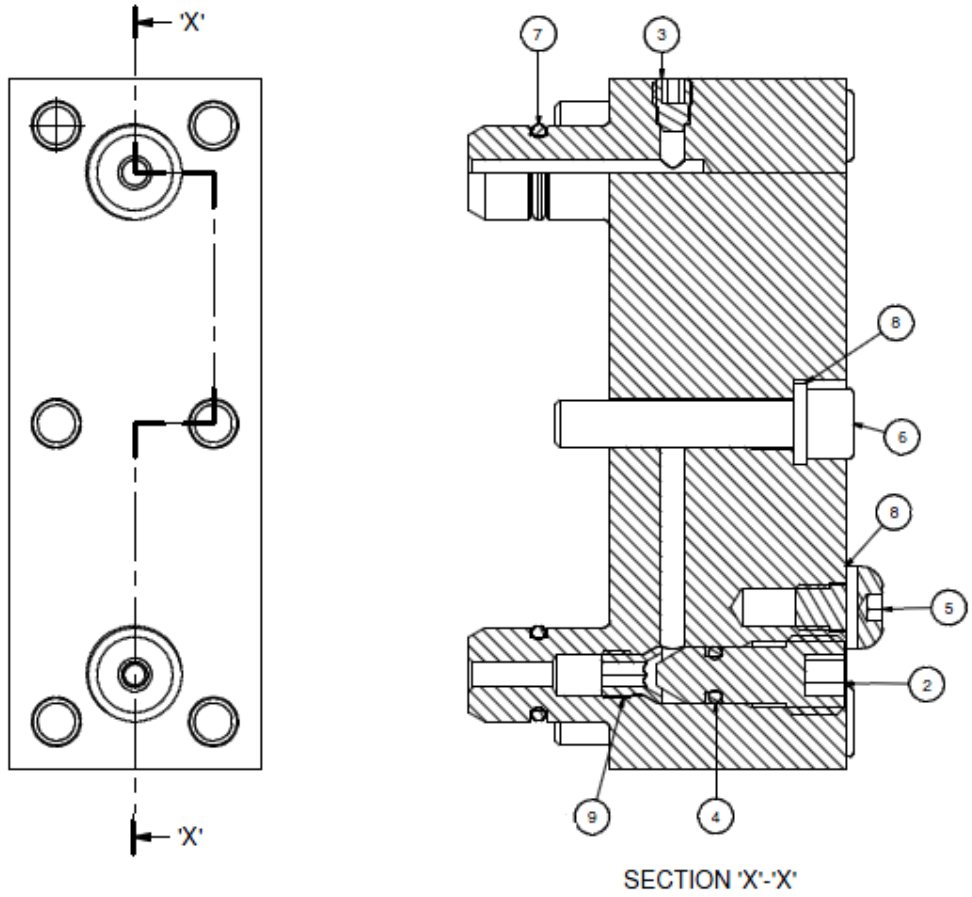


Figure 19: Equalisation Block Assembly

Item Number	Part Number	Quantity	Description
1	190-1716-480	1	GREASE INJECTION SUB
2	190-1703-STL	1	Hollow Lock Screw 3/4-16 (MAC-765)
3	190-1749-STL	1	COMP SPRING (C5515650)
4	190-1760-316	1	AutoClave Plug (CPX40)
5	190-1761-316	1	Autoclave Gland (CGLX40)
6	190-2786-PEK	1	CHECK CONE SEAL
7	801-0117-V90	1	O-Ring - B.S Size 117
8	SHC-0551-HTS	3	Soc Hd Cap Size 3/8 Length 2 in

Table 12: Grease Injection Assembly Parts List Part No 190-2787-HV0

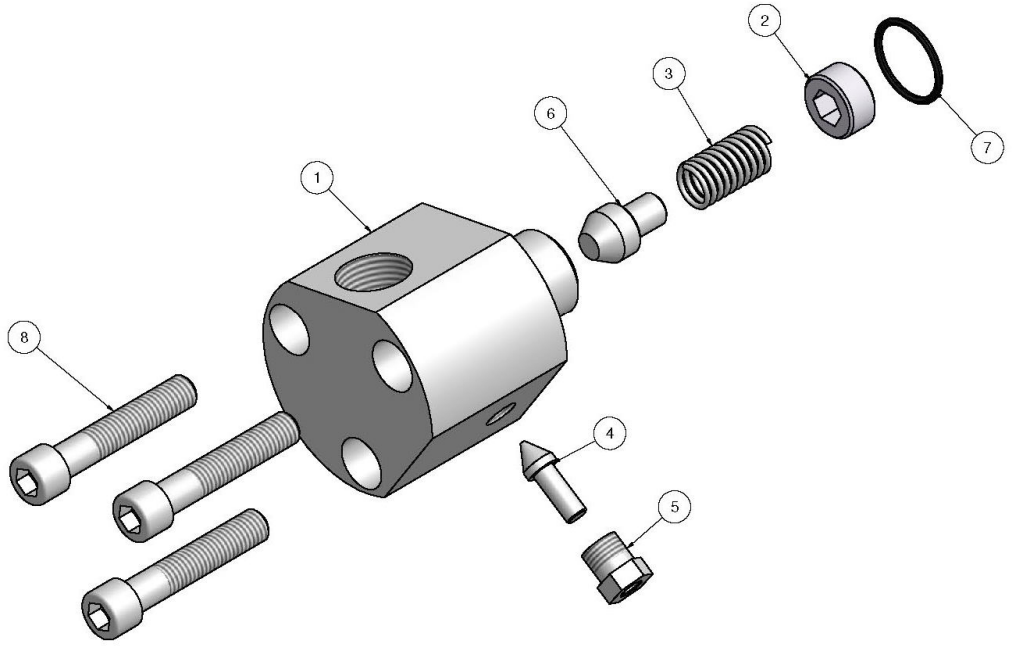


Figure 20: Grease Injection Assembly Drawing

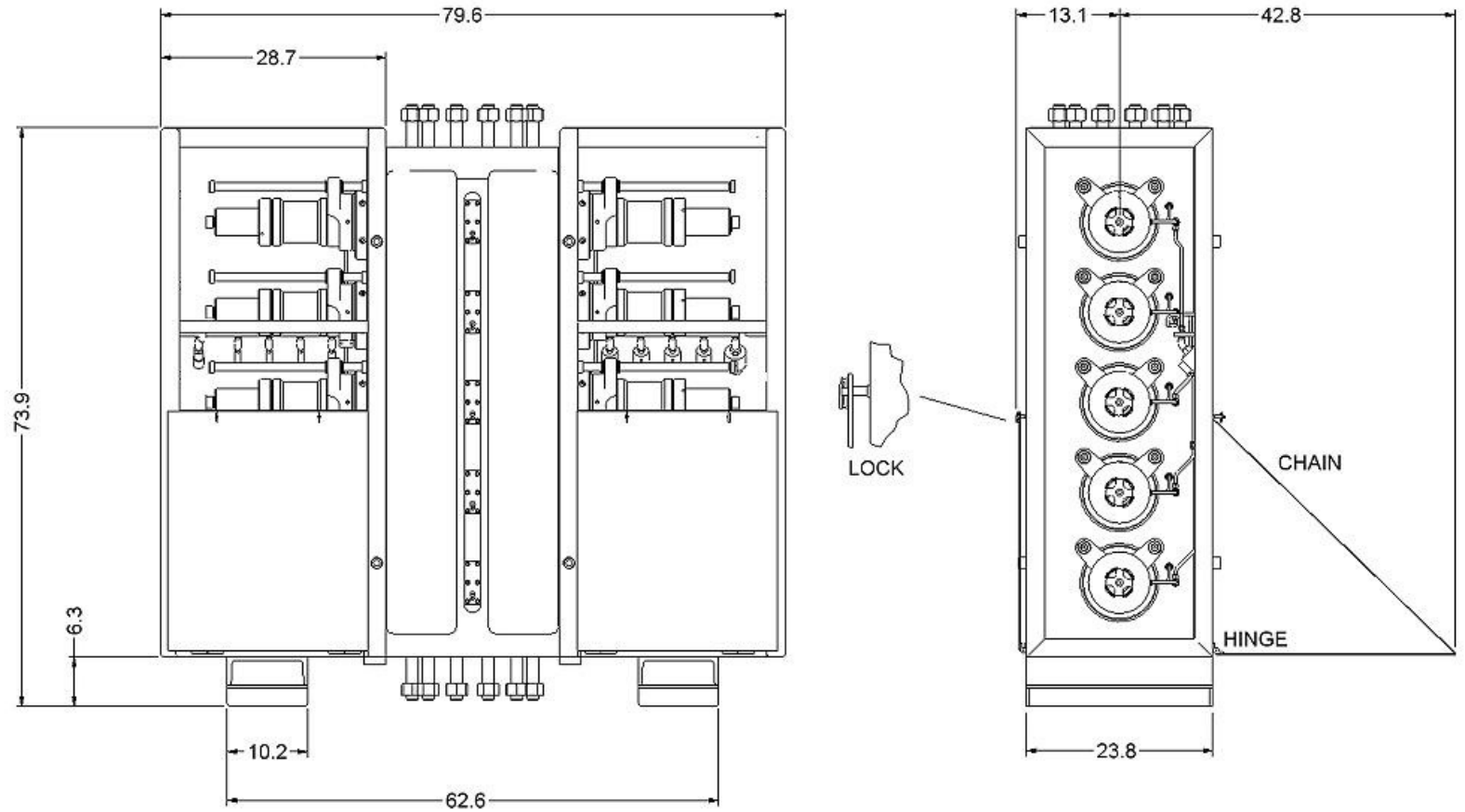


Figure 21: General Layout with crash frame

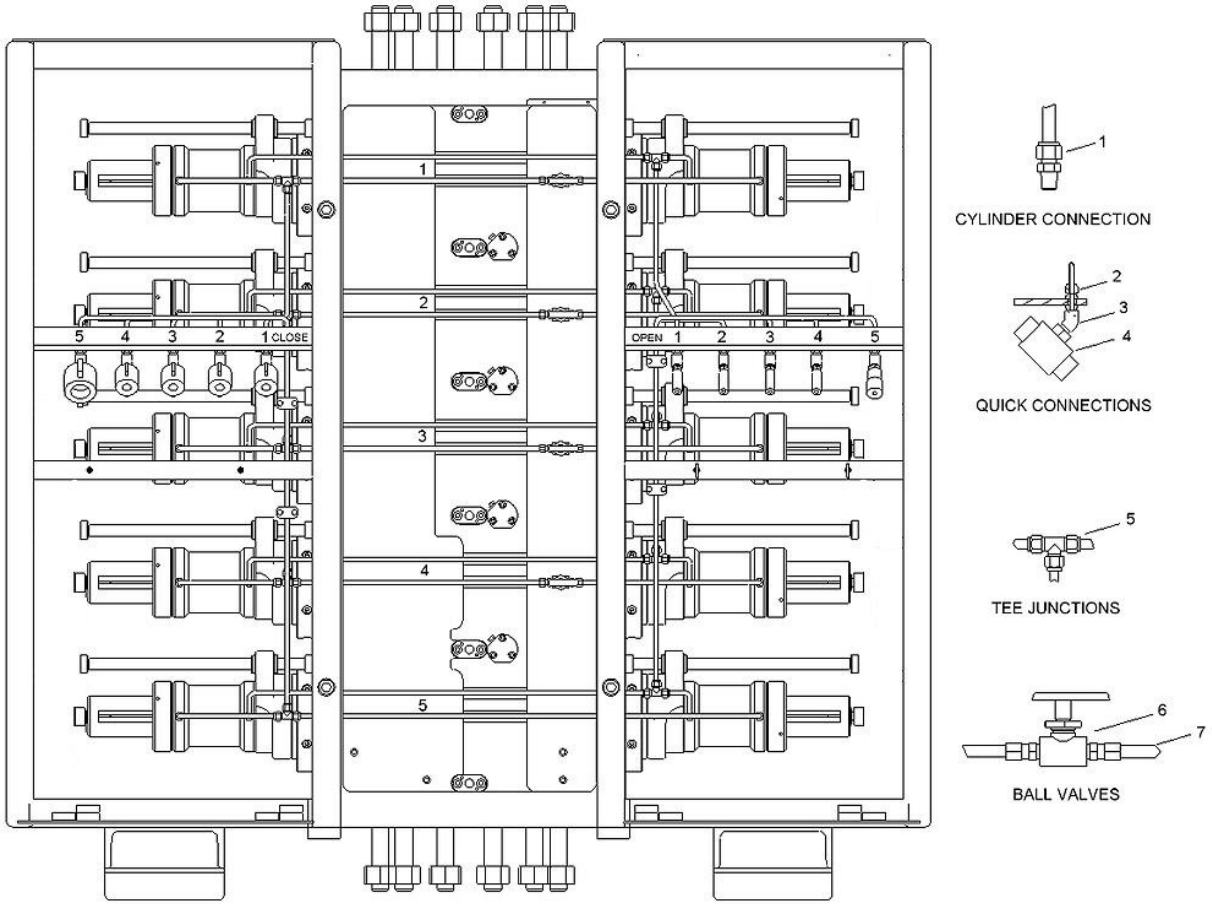


Figure 22: General Layout of hydraulics

Item	Supplier	Description	1 – 4 OPEN	1 – 4 CLOSE	5 OPEN	5 CLOSE
1	Hydrasun	NPT MALE CONNECTOR	3/8 TUBE X ¼ NPT 6MSC4N			
2	Hydrasun	NPT MALE BULKHEAD CONNECTOR	3/8 TUBE X 3/8 NPT 6MBC6N	3/8 TUBE X 3/8 NPT 6MBC6N	3/8 TUBE X ½ NPT 8MBC8N	3/8 TUBE X ½ NPT 8MBC8N
3	Hydrasun	NPT STREET ELBOW 45°	3/8 NPT X 3/8 NPT 6-6SVE	3/8 NPT X 3/8 NPT 6-6SVE	½ NPT X ½ NPT 8-8SVE	½ NPT X ½ NPT 8-8SVE
4	Phoenix Beattie	QUICK RELEASE COUPLING ASSY	3/8 FEMALE	3/8 MALE	½ FEMALE	½ MALE
			QR74AC5-06S		QR74AC5-08SS	
		DUST CAP/PLU	PLUG QR74-PP-06-PVC	CAP QR74-PC-06-PVC	PLUG QR74-PP-08-PVC	CAP QR74-PP-08-PVC
5	Hydrasun	UNION TEE	3/8 TUBE 6ET6			
6	Hydrasun	KELF SEAT BALL VALVE	3/8 TUBE 6A-B6LJ2-SSP			
7	Hydrasun	TUBE – 316 STAINLESS STEEL	3/8 OD – 20 SWG (0.036” WALL THICKNESS)			

Table 13: Hydraulics Parts List

9 Spares

9.1 Available Spare Kits

Use only spares supplied or approved by Phuel Oil Tools Ltd.

It is recommended that sufficient quantities of the following spares be maintained to ensure that the equipment is always available when required.

Elastomeric spares are supplied in Viton material as standard. Other materials are available please specify when ordering.

Part No.	Qty	Item Description	Comments
RDK-5632-HV0	10	Redress Kit for Actuator	All seals required for a full redress
RDK-1863-HH0	5	Redress Kit for Equalisation Assembly	All seals required for a full redress.
RDK-2787-HV0	4	Redress Kit for Grease Injection Assembly	All seals required for a full redress.
801-0119-V90	6	O-Ring	For Sensor Housing

Table 14: BOP Redress Kit Part No. RDK-2220-HV0

Part No.	Qty	Item Description	Comments
802-2163-H85	1	PISTON T-SEAL 5.500	
190-3870-H85	2	ROD T-SEAL 1.625	
801-0439-V90	1	O-Ring - B.S Size 439	
801-0354-V90	1	O-Ring - B.S Size 354	
801-0345-V90	1	O-Ring - B.S Size 345	
802-1699-H85	1	ROD T-SEAL ASSY	
802-2505-H85	1	ROD T-SEAL ASSY	

Table 15: Shear Actuator Redress Kit No (RDK-5632-HV0)

Part No.	Qty	Item Description	Comments
801-0108-V90	1	O-Ring	For Equalisation Valve.
801-0112-V90	2	O-Ring	For Equalisation Block.

Table 16: Equalisation Block Redress Kit (RDK-1863-HV0)

Part No.	Qty	Item Description	Comments
801-0117-V90	1	O-Ring	For Grease Injection Body

Table 17: Grease Injection Redress Kit (RDK-2787 HV0)

Part No.	Qty	Item Description	Comments
190-1715-H70	1	Outer Ram Seal	For All Phuel 6-3/8 BOP Rams
190-5307-H80	1	Wire-line Inner Seal – 6-3/8	Multi-line Blind to 15/32”
190-1748-H90	1	Pipe Inner Seal – 6-3/8	To suit 1.38 Dia Bar
190-5308-H80	1	Blind Wire-line Seal – 6-3/8	Blind

Table 18: Ram Seals (order individual parts as required)

Part No.	Qty	Item Description	Comments
190-1705-STL	1	Shear Blade Set (pair) – 6-3/8	Blades for 1.38 dia Bar

Table 19: Shear Blades (order by pair as required)

Individual seals and parts may be ordered as required. See the parts list in the next section for part numbers.

9.2 Test Fixtures

The following test fixtures are available for order directly from Phuel Oil Tools Ltd

Part No.	Item Description	Comments
900-1806-400	Pressure Test Fixture	For Testing or Equalisation/Injection Block
900-1807-480	Flange End Cap	For blanking end connections (7-1/16 BX)
900-1808-STL	3/8 Hex Key Handle	For removal of rams from body

Table 20: Test Fixtures

9.3 Part Number Deviations

In recent times Phuel has standardised the supply of elastomers in viton material and during that process of change it is possible that some part numbers in the kits previously supplied may differ from that on the specifications above.

In general the last three digits of the part number identify the material and the hardness of the seal. If a redress kit has been supplied before the standardisation it is still acceptable to use the seals supplied providing that the difference in the part number is only in the last three digits.

For example a requirement for O-Ring 801-0108-V90 may be substituted for a part 801-0108-H70 if that was previously supplied in a kit marked for the assembly in question.

This allows the use of previously supplied redress kits and provides for stock management over the period of standardisation.

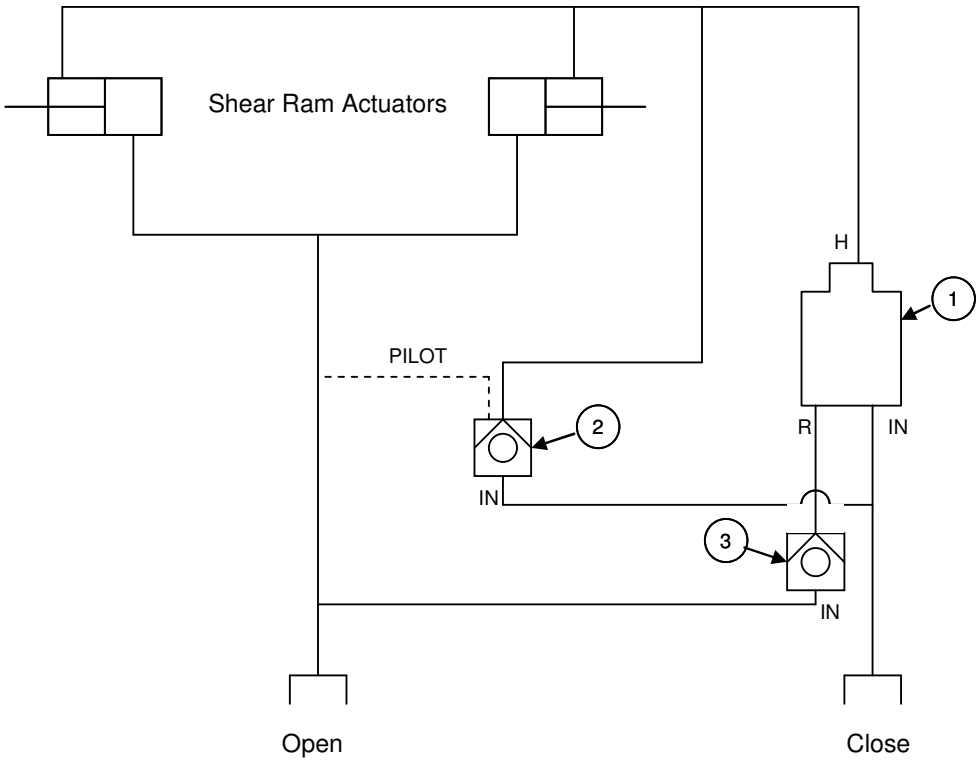
Appendix A Increasing the Shearing Capacity of the BOP

Introduction

In some operations it may be necessary to increase the shearing capacity of the shear rams so that stronger deployment bars can be cut. To achieve this, without increasing the piston area of the actuators, a minibooster system must be added to the shear ram hydraulic circuit. This method avoids the need to change the operating pressures of the BCU, which are normally limited to 3,000 psi.

Method

The hydraulic circuit shown below replaces the standard circuit for the shear rams only.



Item	Part Number	Qty	Description	Manufacturer
1	HC2W-1,5-A-1S	1	Minibooster (x1.5)	Minibooster Hudraulics AS
2	CKCB-XCN	1	Pilot Check Valve 3/8 (3:1 Ratio)	Sun Hydraulics
3	VH36B-D-6T-5-S	1	Check Valve 3/8" . Crack 5psi, 6000psi	DK-LOK

Table A-1. Bill of Materials (Manufacturer is only suggested)

Technical Explanation

The minibooster consists of an oscillating pump together with several free flow through check valves integrated into one small package. When fluid enters the inlet (IN) it freely passes through the booster until the outlet pressure builds up to the match that of the inlet. When that happens, the internal valves close and the oscillating pump then increases the pressure at the outlet up to the magnification factor selected (1.5). The pump discharges fluid through the return port (R) while its operating. The pump automatically operates when there is drop in the outlet pressure.

The remaining circuit manages the supply and return of the minibooster so that the rams can still be closed and opened as normal. When closing, the delivered fluid enters the actuators through the minibooster only, the low pressure fluid is then returned through the open port. When opening, the open pressure will force open the pilot check valve so that the low pressure fluid can be returned through the close port. A separate check valve prevents the open fluid entering the minibooster in the reverse direction.

Implementation

The modification of the hydraulic circuit may be implemented locally using appropriately skilled mechanics. The minibooster should be supported on the frame of the BOP using a suitable clamp and bracket. These components used should be sourced locally.

The implementation work must be tested before being released and the implementation should be documented with a list of parts used, test report and declaration of conformity.

Testing must ensure that the outlet of the minibooster is reaching the desired magnification factor. This should be verified by attaching a gauge on the outlet while cycling the actuators to the closed position. Sufficient open and close cycles should be completed to confirm that the BOP is operating correctly.

Typical Installation Example

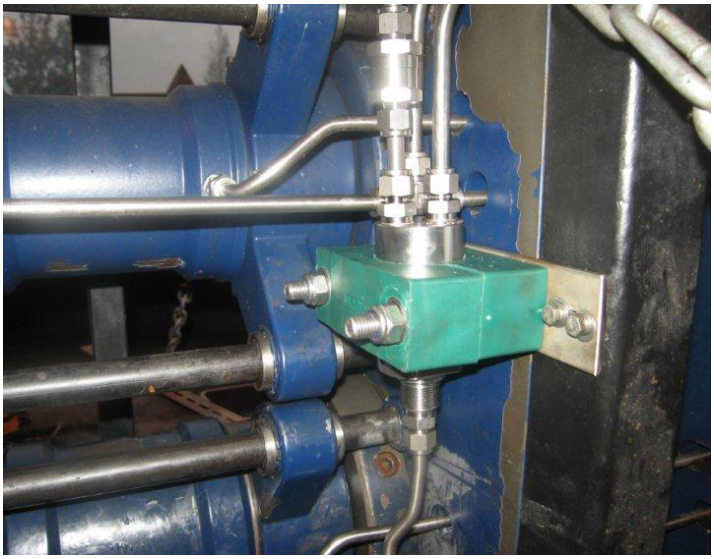


Figure 23: Clamping of the Minibooster to the BOP frame

Figure 24: Clamping of the Minibooster to the BOP frame